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ABSTRACT

This report describes Earth Lab, a project which is demonstrating new ways of using computers for upper-elementary and middle-school science instruction, and finding ways to integrate local-area and telecommunications networks. The discussion covers software, classroom activities, formative research on communications networks, and integration of local and long distance networks. A list of nine references concludes the report. (MES)

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Denis Newman

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LOCAL AND LONG DISTANCE COMPUTER NETWORKING FOR SCIENCE CLASSROOMS*,**

Denis Newman

In the conduct of modern science, collaboration is seen as pervasive both within laboratories and among scientists around the world. No scientist can make a contribution to knowledge without building on the work of his or her colleagues. Journals and shared databases facilitate collaboration locally and over greater distances. Division of labor on scientific problems, such that a group of scientists converge on a joint solution, is also an important aspect of scientific work. Children who are learning science will benefit by being treated as young scientists with the concomitant opportunity to collaborate (Mitchell, 1934; Slavin, 1983). Not only might joint problem-solving facilitate scientific thinking, it could certainly model the process of doing science, thus making it clear to the students that this process can be a lively and active one.

The Earth Lab project, funded by the National Science Foundation, is demonstrating new ways of using computers for upper-elementary and middle-school science instruction. Earth Lab uses a local area network (LAN) to link up the microcomputers in the computer or science lab so that students can easily communicate and share information, as well as work together on simulated science problems. The project is also using a telecommunications network that gives students and teachers communication access to colleagues in other schools--both in the local calling area and around the world.

A major concern of the Earth Lab project is finding ways to integrate these two kinds of computer-mediated communication. Local area networks--which use a cable to directly connect computers, usually in

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the same building--and telecommunication networks--which use a combination of telephone lines and long distance data communication networks--have their own particular strengths and weaknesses. The formative research on educational telecommunications reported here helps to define appropriate roles for these technologies. Scientists use both long distance and local computer-mediated communications. Electronic mail is used within a lab and on the local campus, as well as among scientists spread out around the world. In both the instructional and the real scientific context, the distant communications are harder to coordinate and are best organized as extensions of local communicative activities. Our experience with long distance communication (Levin & Riel, 1985; McGinnis, 1986; Newman & Rehfield, 1985) suggests that a well-designed networking system is marked by coordination between local and long distance functions (Newman, 1985).

Earth Lab: Collaboration in the Classroom

Since September 1986, Earth Lab has been operating in the sixth grade of two schools. Project staff has developed curriculum units in two geography-related areas--weather and climate, and plate tectonics--which provide the instructional context for a test of whether LAN technology can help teachers create a valuable environment for learning science.

We have created or modified several pieces of Apple II software for use in these units. Although they have been designed to work with the Corvus network we are using in the project, the general design principles apply to any network.

Interface. We have created a network interface that will give the teacher and students easy access to the programs, data, and text files. The interface makes it easy for the teacher to create a "workspace" where data from a group project are kept, which can be used by a group of students, or to create a "library" or common area either for a class or for the school as a whole.

Filer. A database management system, the Bank Street Filer, has been modified so that students can easily locate and contribute to a common database for group projects.

Writer. We have created a special version of the Bank Street Writer, a word processing program that is popular in elementary schools. The new Writer allows students to send electronic mail to anyone in the school as well as to students at other schools. Teachers are also able to send messages to individuals or groups of children.

Simulations. A navigation simulation game, "Rescue Mission," has been modified so that four groups of students can pilot their ships simultaneously.

We have designed science activities in which the task is divided among a group of children who use the LAN technology to gather and share their information. These activities involve a fairly high degree of coordination. For example, in our unit on plate tectonics, students are divided into groups, each of which studies a portion of a larger database of facts about where dinosaur fossils were found, the age of the fossil, and what the climate was probably like at the time. Each group is responsible for fossils found on a particular continent. The students, who will have studied the Earth's major climate zones in a previous unit, formulate hypotheses about where the continent might have been positioned; for example, fossils of tropical animals would have lived in the tropics. New information is then added to the database, and the different groups compare their hypotheses and attempt to derive a general pattern of plate movements.

In another example of coordinated classroom work using the LAN, students play a navigation simulation game in which four teams (each at a different computer) attempt to find one another on a simulated map space using various instruments, such as a radio direction finder, radar, and binoculars. The game includes a "CB" function with which the teams can send each other short text messages about their current position and direction.

Written communication is an important aspect of Earth Lab. Text is composed jointly and shared over the LAN as contributions, for example, to a class research project on weather disasters. Electronic mail is also used in the classroom. Students are encouraged, and sometimes assigned, to send the teacher a short message describing their hypotheses about the outcome of an investigation. These messages are printed out and displayed as a basis for class discussion. Since the Earth Lab activities also involve a high degree of coordination among the science teacher, the computer coordinator, and the classroom teachers, the staff use the network to help get their own work done.

Formative Research: Long Distance Networks

The design of Earth Lab draws on two years of experience with communication networks among teachers and students. These earlier projects constitute the formative research that led to the following two design principles:

1. Simplify the access to local and long distance communications by basing it on a single writing system that is also used for conventional writing.

2. Organize activities on the long distance network which do not depend on precise temporal coordination. Leave such activities for the local network.

The first of our formative projects is the Bank Street Exchange, a bulletin board system running on an IBM AT at Bank Street. One activity involved the exchange of pen-pal letters and short essays between elementary classrooms in New York City and San Diego. In this case, there was a combination of local and long distance communication. To avoid the expensive daytime rates on The Source, the commercial network system we were using, students made use of local communication facilities. In San Diego, the schools used the UCSD electronic mail system; in New York, the Exchange was used. Messages were portaged via The Source between the two cities. For example, in New York, children called up the Exchange from their classrooms--and sometimes from home--in order to write messages to other children. We downloaded these messages to an Apple II, and then uploaded them to The Source after business hours when the rates were lower. The same procedure was used for messages going in the opposite direction.

An important observation from this and other projects using long distance communication is that electronic communication tends to be sporadic, and this feature increases with the organizational differences of and distance between the communicating sites. It is difficult to create tightly coordinated activities over distances because, for example, curricula, schedules, and holidays vary considerably. We ran into this problem continually with the pen-pal project. One classroom would become active and send out their messages at a time when the other class was on vacation or engaged in other language arts activities. By the time the messages were answered, they were old news or the children who had sent them had moved on to other interests. In addition, because the messages were being portaged and, in some cases, depended on undergraduate assistants, semester breaks caused further delays. Thus, in spite of the technical speed of the medium, the messages often took much longer to arrive than they would if sent through the regular mail. Often, messages sent over a period of time would arrive in bunches. Another reason for sporadic transmission was the relatively sparse amount of communication over the long distance channels. Because new messages were not being received every day, sites tended to log in less frequently. Although messages can be transmitted in the space of a few seconds, it may take a while before they are answered.

While pen-pal letters may seem to be a simple application of the technology, they actually require fairly good coordination between sites. Corresponding from home with pen and paper is a simpler situation because, among other factors, there is no need to accommodate the teachers' priorities for computer use. But we were faced with coordinating the writing activities of one particular child with the writing activities of another particular child; if one or the other child failed to respond for a few weeks, the activity broke down and led to frustration on both sides.

The exchange of messages became more successful when an energetic UCSD undergraduate took it on as her course project. She moved the activity from personal letters to "editorials" about current events. The bombing of Libya took place the day before she began working with the group of San Diego students. The San Diego messages, which expressed the children's opinions about the event, were answered relatively quickly by the New York students and led to several exchanges about this and other events. It is notable that the coordination in this case was facilitated by a dedicated undergraduate on one end and an enthusiastic computer coordinator on the other. Their efforts were made easier by its being a class project. Any student in either class could write an editorial; the success of the exchange did not depend on a specific student receiving a message from some other specific student on the other side of the continent.

A second project at Bank Street that uses long distance electronic communication is the Mathematics, Science and Technology Teacher Education (MASTTE) project (McGinnis, 1986; Quinsaat, Friel, & McCarthy, 1985). The project serves 12 sites around the country which are implementing Bank Street's multimedia science program, The Voyage of the Mimi. Nine of these sites have been communicating with us and with each other via a computer conferencing system called Parti, which is publicly available through The Source.

The most successful activity that we organized on the MASTTE network illustrates an appropriate level of coordination that can be achieved over long distance networks linking classrooms. The "guest expert" series has been very popular among a number of the sites and has elicited a large response. Its structure is much simpler than either the pen-pal or "editorial" exchange because there is no need for any particular child or class to respond to any other child or class. We announced over the network that a series of experts, several of whom were featured in the TV show, The Voyage of the Mimi, would be available to answer children's questions. Teachers got questions from their class and sent them in via the network or, in some cases, the telephone. The expert wrote answers to the questions which were then distributed over the network. Even this

simple activity required coordinating the phone calls so that the questions coincided with the experts' schedules. If a site did not respond, it had little or no effect on the value and enjoyment of the activity by the other sites.

Integrating Local and Long Distance Networks

Where a group of individuals or sites have no intrinsic functional relationship to each other, a considerable amount of extrinsic coordination is necessary in order to use long distance networks for highly coordinated science activities. Networks that have successfully implemented coordinated science activities among distant classrooms, such as the Intercultural Learning Network (Levin, Riel, Miyake, & Cohen, in press), have relied on supervision by university-based researchers who form a functional research community with purposes beyond the implementation of classroom activities. In our earlier work, we found that a group of district people from around the country could successfully use the network to plan a conference (Newman & Rehfield, 1985). In this case, the group had a common purpose outside the activities for which the network was instrumental.

Classrooms in distant cities which join a common network activity often have no connection with one another outside the activity itself. In these cases, it may be more appropriate to design activities in which sites contribute to a common database of material or information but where the contribution of any one site is not critical. The guest expert activity meets this description, as do "telecourses" in which geographically scattered students take part in "class discussion" using computer-mediated conferencing (Harasim, 1986). Joint data-collection activities, in which the data from each site is critical to the experimental outcome, will probably require a considerable amount of extrinsic coordination among distant, unrelated classrooms.

The situation is quite different at the local level of the classroom or school. Here, planning a science curriculum is not hindered by differences in schedules. Within a classroom, planning meetings are not necessary, and even where the activity might involve other teachers in a grade level or, for example, the school's computer coordinator, face-to-face meetings are relatively easy to arrange. Within the science class, activities can be divided among different children, who then come together for discussions. Using a local area network with a common disk storage device makes such coordination easier and, we hope, more enjoyable for students.

One of the features of the Earth Lab classroom environment is electronic mail. This simple system is based on the Bank Street Writer, the word processor being used for writing instruction in the schools

with which we are working. We have modified the program by adding a SEND MAIL and an OPEN MAIL function. In this way, students are able to use their familiar writing environment for sending messages. Electronic mail, within the classroom and among classrooms using a common computer or science lab, simulates the way scientists use electronic mail in a scientific lab or on a campus. We have devised activities that require groups of students to communicate with other groups, thus integrating science and writing, and focusing students' attention on the importance of clear and unambiguous expression in science.

As a result of our experiences with long distance networking, we have developed an efficient portage connection between the local classroom network and the longer distance networks available via modem connections. Each day the Earth Lab coordinator uses the modem to call out to the Bank Street Exchange, the Source, and other bulletin boards of interest, download messages to the hard disk of the local network, and then distribute each message to the directories of individual students. Ultimately, this function could be automated with a special purpose program.

Through this portage system, we are beginning to solve two of the major problems we have encountered with networking applications in education. First, by having children use the same software, in this case the Bank Street Writer, for all communications--papers, local and long distance messages--we have simplified the process by making it necessary to know only one method of entering text. Second, we have reduced the problem of sporadic long distance communication by providing a single source for all communications; if all communications come over one channel, children are less frustrated by the delays in the long distance networks. The probability of getting some message every day is high enough to maintain interest; when the long distance messages do arrive, they simply provide an additional motivator.

Our goal is to make written communication as routine a part of doing science for children as it is for real scientists. To achieve this we are protecting children from the difficulties and frustrations of long distance networks, while providing them with interesting communications from outside the school. It is important to simplify the process of communication in order for it to become a routine part of education rather than the specific domain of enthusiasts.

Another reason for encouraging the development of communication activities is to help children reflect on their own understanding of a problem by comparing it with the understanding of another. However, we must temper our ambitions in the realization that "instantaneous" electronic communication will not overcome the wide differences

in schedules of people in different parts of the country or the world. Nonreal time can only be stretched so far. The combination of local and long distance communication into a single system will help to close the gaps in responses. The coordination of local and long distance communication will allow us to make the best use of both.

References

Harasim, L. M. (1986). Computer learning networks: Educational applications of computer conferencing. Paper presented at the meeting of the American Educational Research Association, San Francisco, CA.

Levin, J. A., & Riel, M. (1985). Educational electronic networks: How they work (and don't work). Paper presented at the meeting of The American Educational Research Association, Chicago, IL.

Levin, J. A., Riel, M. M., Miyake, N., & Cohen, M. (in press). Education on the electronic frontier: Teleapprentices in globally distributed educational contexts. Contemporary Educational Psychology.

McGinnis, M. R. (1986). Supporting science teachers through electronic networking. Paper presented at the New England Educational Research Organization, Rockport, ME.

Mitchell, L. S. (1963). Young geographers: How they explore the world and how they map the world. New York: Basic Books. (Originally published in 1934)

Newman, D. (1985). Networking systems for teacher education: Design issues. Paper presented at the meeting of the Northeastern Educational Research Association, Kerhonkson, NY.

Newman, D., & Rehfield, K. (1985). Using a national network for professional development. Paper presented at the meeting of the American Educational Research Association, Chicago, IL.

Quinsaat, M., Friel, S., & McCarthy, R. (1985). Training issues in the teaching of science, mathematics and the use of technology. In L. Loucks (Chair), "The Voyage of the Mimi": Perspectives of teacher education. Symposium conducted at the meeting of the American Educational Research Association, Chicago, IL.

Slavin, R. E. (1983). Cooperative learning. New York: Longman.